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PROVISIONAL PATENT APPLICATION UNDER §111(b)	*Attorney Docket No.* 091395-9448
	First Named Inventor
	Richard F. Murphy
	CERTIFICATION UNDER 37 CFR 1.10
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Alexandria, VA 22313-1450

Sir:

Enclosed for filing is a complete provisional patent application entitled "SWITCHING FINGER FOLLOWER ASSEMBLY" invented by:

Richard F. Murphy
187 Hodges Hill Road
Torrington, CT 06790

Matthew J. Deierlein
Torrington, CT 06790

and including the following documents:

Specification including Claims - 7 pages

Abstract of the Disclosure

Drawings - 4 sheets

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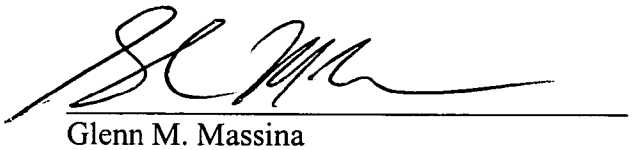

Glenn M. Massina
Reg. No. 40,081
Michael Best & Friedrich LLP
100 East Wisconsin Avenue
Milwaukee, Wisconsin 53202-4108

Date: December 13, 2004
cc: Docketing
Wkg Atty. GMM
Resp Atty. DBS

SWITCHING FINGER FOLLOWER ASSEMBLY

BACKGROUND

[0001] The present invention relates to mechanisms for altering the actuation of valves in internal combustion engines; more particularly, to finger follower type rocker arms having means for changing between high and low valve lifts; and most particularly, to a two-step finger follower type rocker arm assembly, having a fixed central cam follower and a pair of pivotal lateral cam followers disposed on the finger follower body, and having locking means for latching and unlatching the lateral cam followers from the finger follower body to shift between high lift and low lift modes.

[0002] Variable valve activation (VVA) mechanisms for internal combustion engines are well known. It is known to be desirable to lower the lift of one or more valves of a multiple-cylinder engine, especially intake valves, during periods of light engine load. Such deactivation can substantially improve fuel efficiency.

[0003] Various approaches have been disclosed for changing the lift of valves in a running engine. One known approach is to provide an intermediary cam follower arrangement which is rotatable about the engine camshaft and is capable of changing both the valve lift and timing, the cam shaft typically having both high-lift and low-lift lobes for each such valve. Such an arrangement can be complicated and costly to manufacture and difficult to install onto a camshaft during engine assembly.

[0004] Another known approach is to provide a deactivation mechanism in the hydraulic lash adjuster (HLA) upon which a cam follower rocker arm pivots. Such an arrangement is advantageous in that it can provide variable lift from a single cam lobe by making the HLA either competent or incompetent to transfer the motion of the cam eccentric to the valve stem. A shortcoming of providing deactivation at the HLA end of a rocker arm is that, because the cam lobe actuates the rocker near its longitudinal center point, the variation in lift produced at the valve-actuating end can be only about one-half of the extent of travel of the HLA deactivation mechanism.

[0005] Still another known approach is to provide a deactivation mechanism in the valve-actuating end of a rocker arm cam follower (opposite from the HLA pivot end) which locks and unlocks the valve actuator portion from the follower body. Unlike the HLA deactivation approach, this approach typically requires both high-lift and low-lift cam lobes to provide variable lift.

[0006] Another known approach is to provide a rocker arm cam follower with a finger body having a first cam follower positioned within the finger body and a secondary cam follower positioned outside each lateral edge of the finger body. These rocker arm cam followers generally require excessive lateral space. In some designs, the first cam follower is selectively moveable relative to the finger body and in other designs, the secondary cam followers are selectively moveable relative to the finger body. The moveable members generally are axially moveable or pivot about a secondary axis which adds complexity to the design or fails to provide smooth motion.

SUMMARY

[0007] The present invention provides a two-step finger follower rocker arm assembly for variably activating a gas valve of in an internal combustion engine having a camshaft having a central lobe and at least one lateral lobe adjacent a first side of the central lobe. The finger follower rocker arm assembly comprises a follower body having a first end for engaging the engine and a second end for engaging a valve stem of the gas valve. The follower body has a passage formed in the body between the first and second ends and has a first bore traversing the passage. A central follower is positioned in the passage and is configured for engagement with the central lobe. A first lateral follower is pivotally positioned in the passage on a shaft extending through the first bore and is configured to engage the at least one lateral cam lobe. A latching mechanism is positioned on the follower body for latching the lateral follower to the body to cause the motion of the at least one lateral cam lobe to be translated to the body in a first rocker assembly mode having a first valve lift capability and for unlatching the lateral follower from the body to cause engagement of the central follower with the central camshaft lobe to provide a second rocker assembly mode having a second valve lift capability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Fig. 1 is an isometric view of a finger follower assembly that is a first embodiment of the present invention as it is mounted in an engine.

[0009] Fig. 2 is an exploded view of the finger assembly of Fig. 1.

[0010] Fig. 3 is a cross section view of the finger assembly of Fig. 1 with the locking mechanism engaged.

[0011] Fig. 4 is a similar view to Fig. 3 with the locking mechanism disengaged.

[0012] Fig. 5 is an exploded view of the locking mechanism of the first embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The present invention will be described with reference to the accompanying drawing figures wherein like numbers represent like elements throughout. Certain terminology, for example, "top", "bottom", "right", "left", "front", "frontward", "forward", "back", "rear" and "rearward", is used in the following description for relative descriptive clarity only and is not intended to be limiting.

[0014] Referring to Figs. 1-4, a finger follower rocker arm assembly 10 that is a first embodiment of the present invention will be described. As shown in Figs. 1 and 2, the rocker arm assembly 10 includes a finger body 11 with one end 12 configured to engage the engine such as through a typical lash adjuster 2 and a second end 13 configured to engage a typical valve stem 3. Opposed side walls 14 extend between the ends 12, 13 and define an opening 15 in the central area of the finger body 11.

[0015] A central cam follower 20 is mounted in the opening 15 with a lateral follower 30 on each side thereof. Each lateral follower 30 is positioned between the central cam follower 20 and a respective side wall 14 of the finger body 11. The central cam follower 20 and the lateral followers 30 are supported on a single shaft 17 extending through a bore 18 extending through the side walls 14 transverse to the opening 15. The preferred central cam follower 20 includes a cylindrical race 22 with a roller complement 24 positioned therein such that the cylindrical race 22 is rotatable about the shaft 17. The central cam follower 20 is positioned to contact the low or zero lift cam lobe 8, as illustrated in Fig. 1.

[0016] Referring to Figs. 2-4, each lateral follower 30 has a body portion 32 with a through bore 34 configured to receive and pivot about the shaft 17. Each through bore 34 is co-axial with the shaft 17 and the central cam follower 20 along axis CA. Each lateral follower 30 further includes a contact portion 36 extending from the body portion 32. The contact portion 36 includes a convex contact surface 37 configured to contact a respective high lift lobe 9 as illustrated in Fig. 1. The contact surface 37 has an axis of rotation OA that is offset from the central axis CA. As such, contact of the respective high lift lobe 9 with the contact surface 37 will cause a pivoting force on the lateral follower 30. As will be described hereinafter, each lateral follower 30 is lockable relative to the finger body 11 such that the pivoting force of the high lift lobe 9 will be transmitted to the finger body 11. In the unlocked condition, the lateral follower 30 simply pivots about the central axis CA without imparting any significant force on the finger body 11. Each lateral follower 30 is biased toward an upper position by a torsion spring 31 or the like. In the preferred embodiment, a torsion spring 31 is positioned about each body portion 32. As shown in Fig. 2, the contact portion 36 defines an open space 35 relative to the body portion 32 to receive and retain a first end 31a of the torsion spring 31. As shown in Fig. 3, the opposite end 31b of the torsion spring 31 is received in the opening 15 and abuts a transverse surface 16 thereof.

[0017] A locking tab 38 is provided on each lateral follower 30. Each locking tab 38 is configured to be selectively engaged by a locking mechanism 40 to prevent pivoting of the lateral followers 30 about the shaft 17. The locking tab 38 protrudes from the lateral follower body portion 32. When positioned in the finger body the end faces of each locking tab 38 contact each other forming an opening of the proper size for the cam roller 20. This prevents the lateral followers 30 from "pinching" the cam roller during operation. In the locked condition, see Fig. 3, the valve lift is controlled by the high lift lobes 9 as the pivoting force is transmitted through the lateral followers 30, through the locking mechanism 40 and to the finger body 11. When the locking mechanism 40 is disengaged, see Fig. 4, the valve lift is controlled by the low lift lobe 8 through the central cam follower 20, with the lateral followers 30 pivoting about the shaft 17 against the force of the torsion springs 31. The locking tabs 38 are sized to form a properly sized slot for the central cam follower 20.

[0018] A preferred locking mechanism 40 will be described with reference to Figs. 4 and 5. The preferred locking mechanism 40 includes a hydraulic actuator 42 attached to the top of the finger

body 11 over the lash adjuster directly or by a base plate 43. The hydraulic actuator 42 has an outer body with a cylindrical bore 44 and a piston 45 inside the bore. Pressurized oil is supplied from the lash adjuster to the bore 44 through a channel 46 in the base plate 43. A spring 47 is positioned in the bore 44 and acts on the piston 45 biasing it to the oil supply end of the bore 44. Sufficient oil pressure causes the piston 45 to move away from the oil supply end. A locking bar 48 is provided on the free end of the piston 45 and is moveable by oil pressure toward the locking tabs 38 of the lateral followers 30. The locking bar 48 can move under the contact tabs 38 and contact their locking surfaces 39 to engage the locking mechanism 40. The locking bar 38 bridges a slot in the center portion of the finger. When the oil pressure is decreased to a pre-determined level, the spring 47 moves the piston 45 and locking bar 48 from under the locking tabs 38, allowing the lateral followers 30 to pivot in the opening 15, thus disengaging the locking mechanism 40.

[0019] In order to accurately control the motion of the engine valve, the position of the lateral follower contact surfaces 37 needs to be precisely positioned relative to the finger body valve stem contact surface 23 and the lash adjuster contact surface 22. Variation in this position may cause the locking mechanism 40 to not engage or not allow the valve to completely open in the high lift mode. This variation can be caused by normal deviations during the manufacture of the finger body 11 and lateral followers 30. The surface 49 of the locking bar 38 that contacts the lateral followers 30 preferably has a slightly tapered shape with the locking tabs 38 locking surfaces 39 having a matching taper. The further the locking bar 48 moves under the locking tabs 38, the higher the lateral follower contact surface 37 is relative to the finger body 11. Located on the actuator piston 45 is an adjusting ring 50 that limits the travel of the piston 45 by contacting the actuator end cap 52 which is attached to the actuator body. This ring 50 is moveable on the piston 45 only by a force which is significantly higher than the force exerted by the piston 45 under high pressure oil conditions. During the manufacture of the finger follower assembly 10, when the actuator 42 is first assembled onto the finger body 11, the adjusting ring 50 is positioned significantly towards the locking bar 48 end of the piston 45. The assembled finger assembly 10 can then be put in a fixture that locates the lateral followers 30 to accurately represent the position of the contact surface 37 as when assembled into an engine. The locking bar 38 is then positioned under the locking tabs 38 the proper distance such that the tapered surfaces 49, 39 of the locking bar 48 and locking tabs 38, respectively, cause the lateral follower contact surfaces to rise to the proper cam contact height.

While the locking bar 48 and piston 45 are being moved, the adjusting ring 50 is forced to slide down the piston 45 by contact with the end cap 52. The adjusting ring 50 will thereby be set to a desired stop position such that during normal operation in the engine, the adjusting ring 50 provides a stop for the piston travel, thus ensuring the lateral follower contact surfaces 37 are at the proper height.

* * *

What is claimed is:

1. A two-step finger follower rocker arm assembly for variably activating a gas valve of in an internal combustion engine having a camshaft having a central lobe and at least one lateral lobe adjacent a first side of the central lobe, comprising:

a follower body having a first end for engaging the engine and a second end for engaging a valve stem of the gas valve and having a passage formed in the body between the first and second ends and having a first bore traversing the passage;

a central follower positioned in the passage and configured for engagement with the central lobe;

a first lateral follower configured to engage the at least one lateral cam lobe and pivotally positioned in the passage on a shaft extending through the first bore; and

a latching mechanism disposed on the follower body for selectively latching the lateral follower to the body to cause the motion of the at least one lateral cam lobe to be translated to the body in a first rocker assembly mode having a first valve lift capability and for unlatching the lateral follower from the body to cause engagement of the central follower with the central camshaft lobe to provide a second rocker assembly mode having a second valve lift capability.

ABSTRACT

[0020] A two-step finger follower rocker arm assembly comprising a follower body having a first end for engaging the engine and a second end for engaging a valve stem of the gas valve. The follower body has a passage formed in the body between the first and second ends and has a first bore traversing the passage. A central follower is positioned in the passage and is configured for engagement with the central lobe. A first lateral follower is pivotally positioned in the passage on a shaft extending through the first bore and is configured to engage the at least one lateral cam lobe. A latching mechanism is positioned on the follower body for selectively latching the lateral follower to the body.

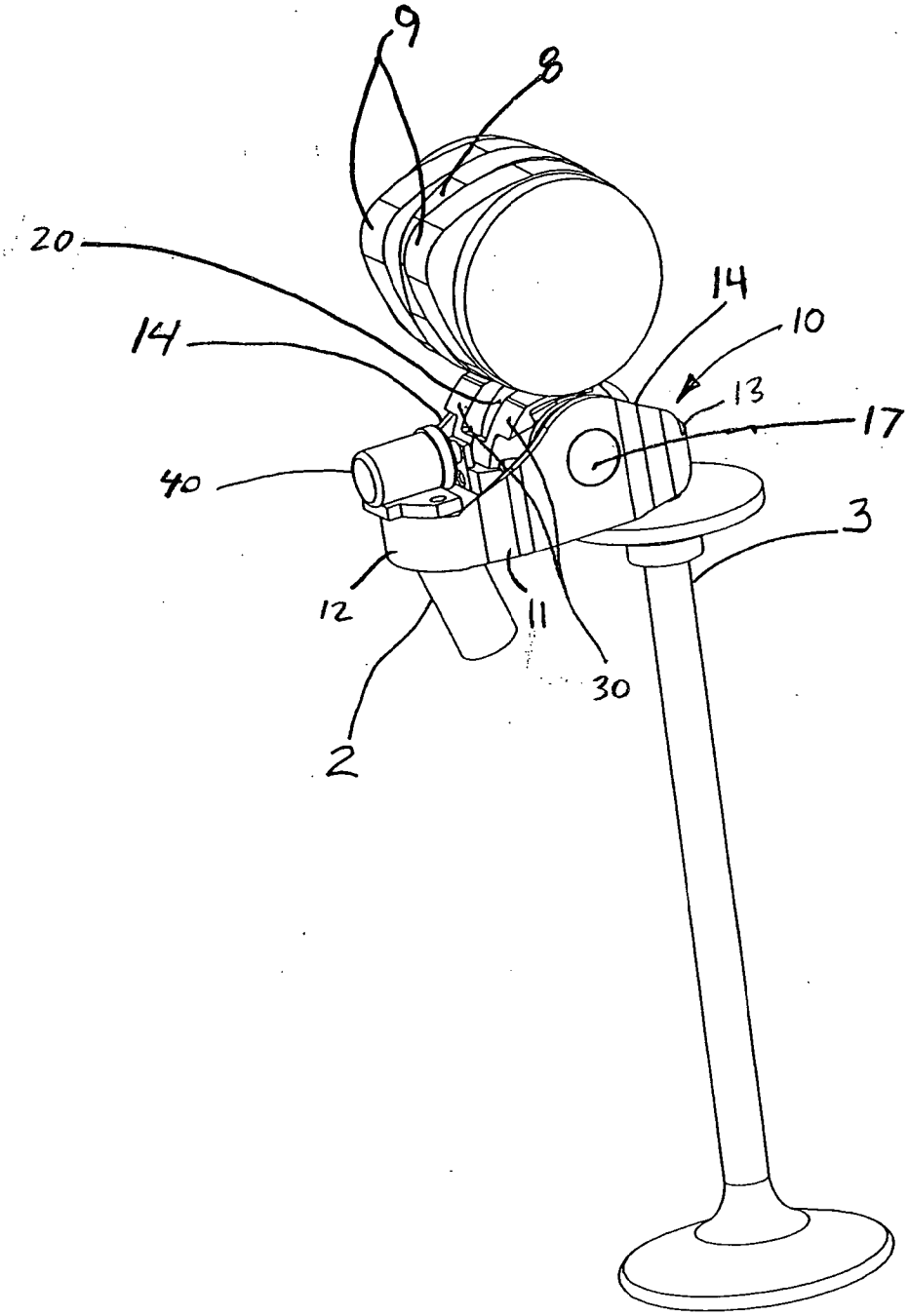

Fig. 1

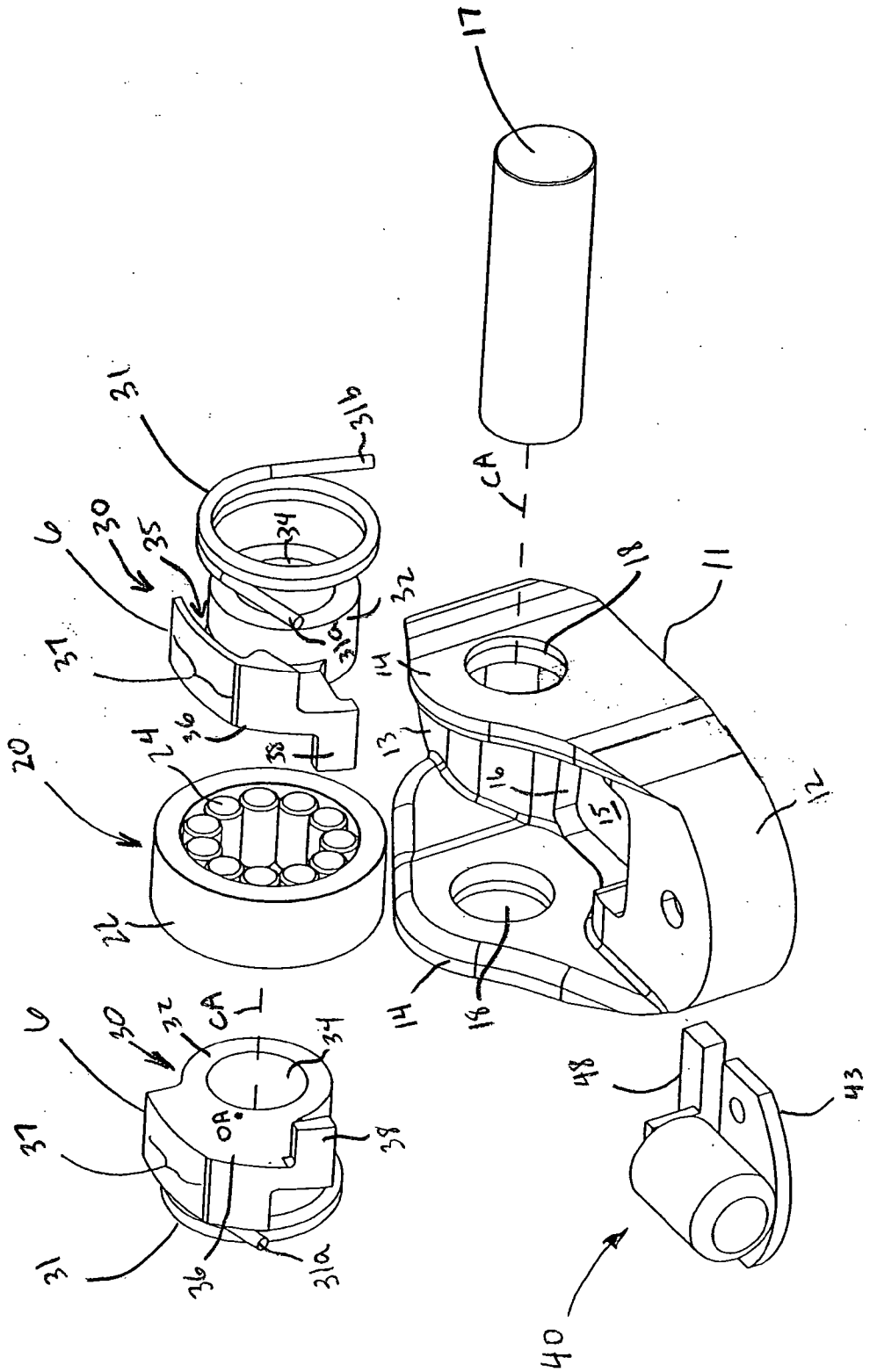
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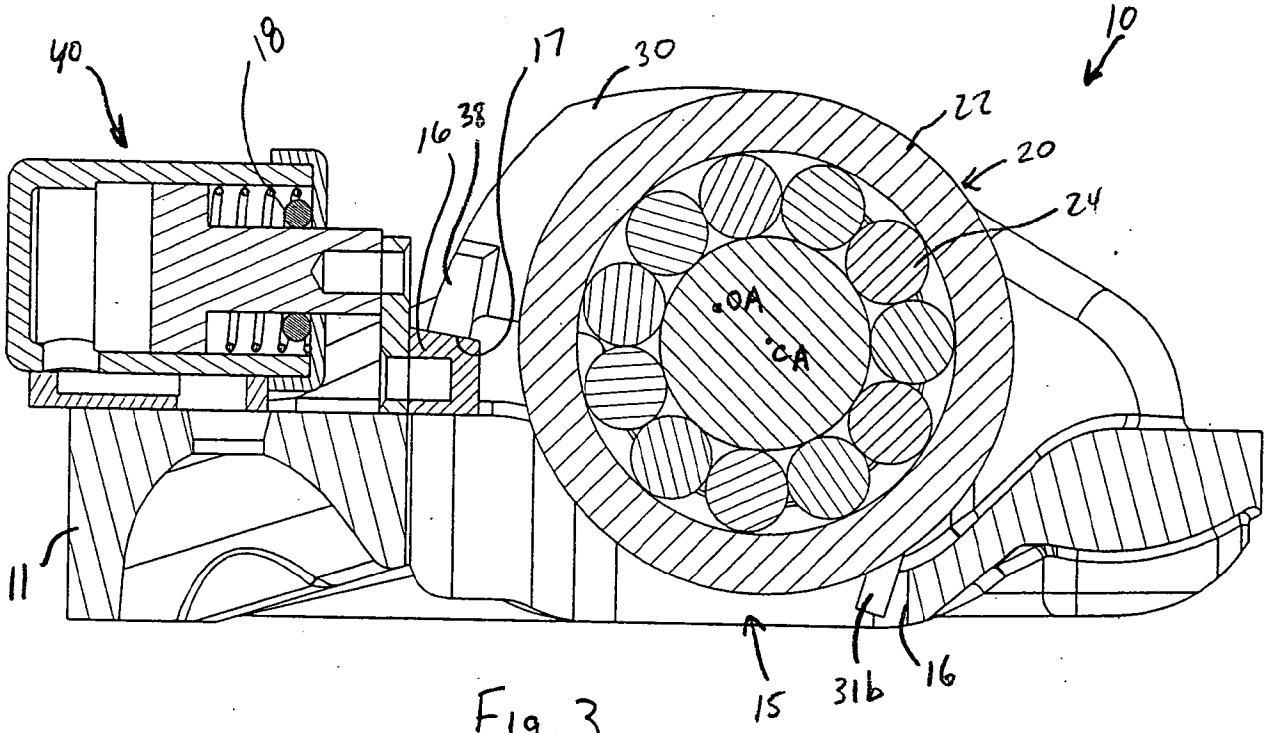
Fig 2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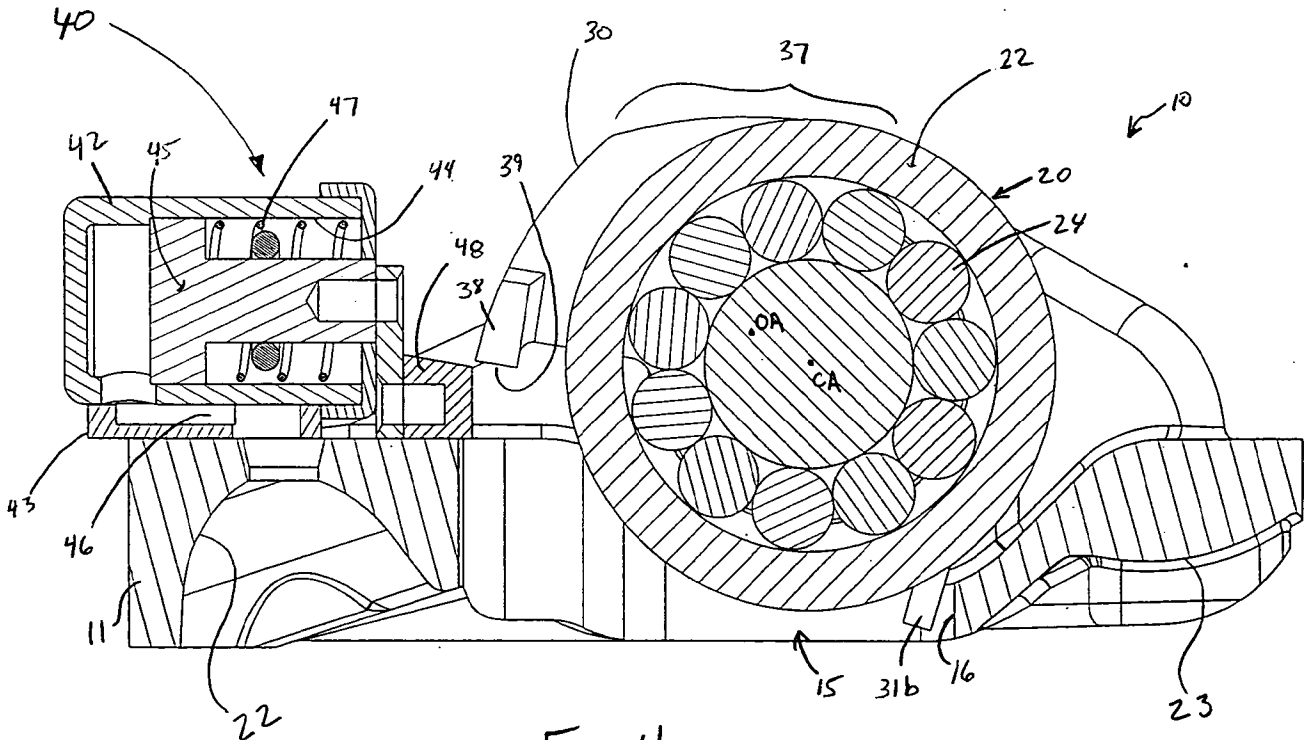
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Fig. 4

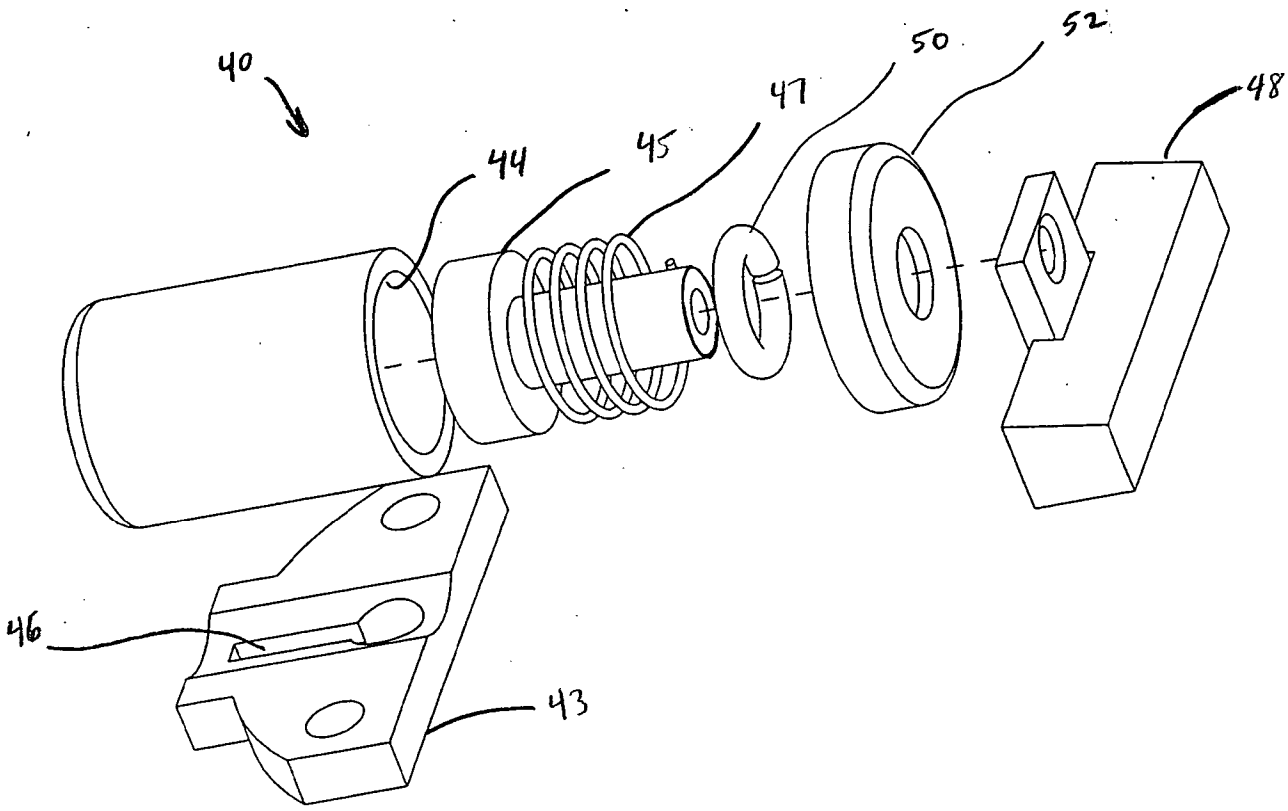

Fig. 5